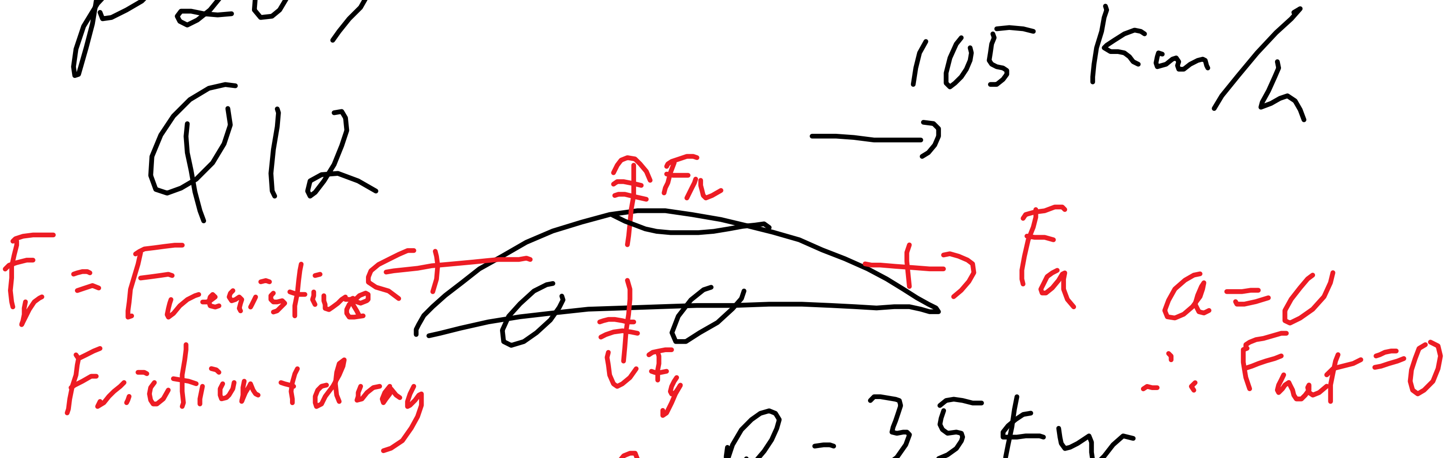
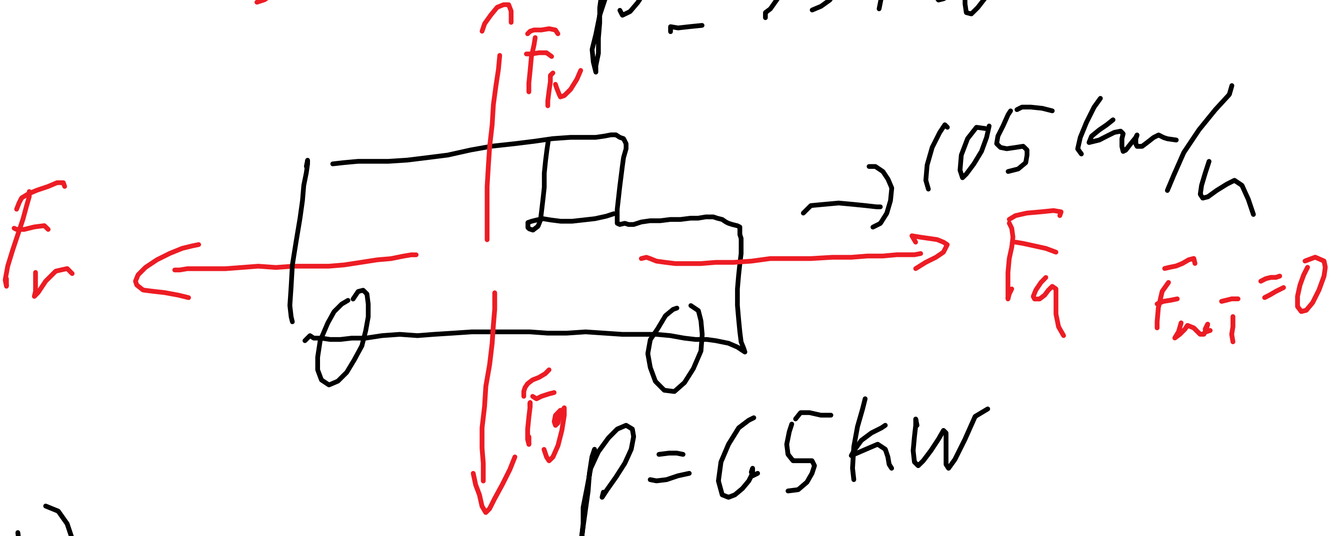
Thursday, January 07, 2016 8:48 AM

Efficiency and Mechanical Advantage

p203

Q12





b) Pushes air forward

Pushes ground down + back

c) $F_a = ?$ $P = \frac{W}{t} = \frac{Fd}{t}$ v

$$P = Fv$$

$$F = \frac{P}{v} = \frac{35\,kW}{105\frac{km}{h}\left(\frac{1000\,m}{km}\right)\left(\frac{h}{3600\,s}\right)}$$

$$F = 1.2\,kN$$ Sports car

$$F = 2.2\,kN$$ big car

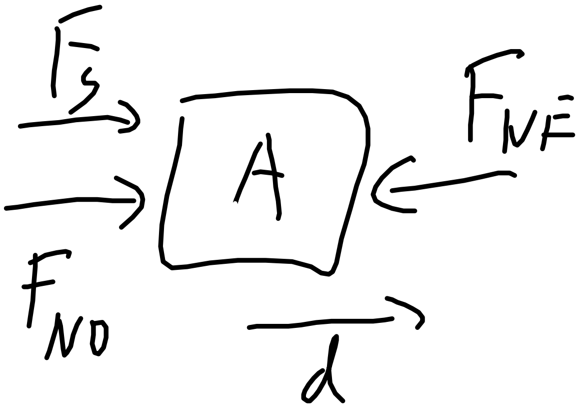
d) chemical energy in the fuel - break chemical bonds

CR 1.1
Work is a change in energy or applying a force through a distance.

1.2 No work is done by gravity or the normal force because the force is perpendicular to the direction of motion. Friction does negative work on the ball. Your hand does positive work.

1.3 Yes, there is a change in energy, you go faster or slower. The friction from the ground does not move through a distance, so it isn't doing work. Your body is doing work, not the ground.

1.4 Yes,



All the forces are doing work, some positive, some negative

Simple Machines
Objects that changes forces and distances for the force.
Eg. Pulley, ramp, lever, wheel and axel

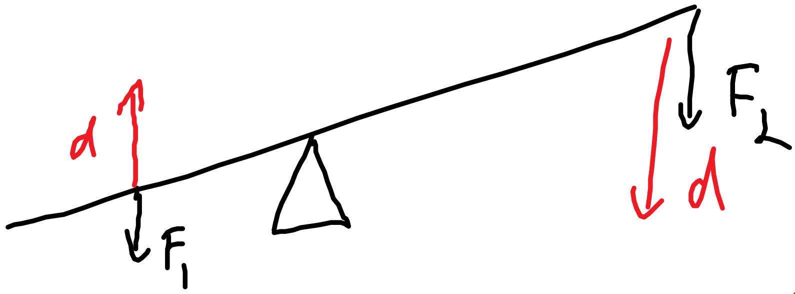
Hole punch is a lever, like a wrench or jack (something to lift cars when you have a flat)

Wheel and axel - screwdriver, bicycle gears

Mechanical Advantage, MA

The ratio of the input force to the output force

Eg. With a lever and a fulcrum:



by conservation of energy

Δ energy in = (ideal) Δ energy out

$$W_{in} = W_{out}$$

$$F_{in} d_{in} = F_{out} d_{out}$$

$$MA = \frac{F_{out}}{F_{in}} = \frac{d_{in}}{d_{out}}$$ Ideal Machine

$$\text{Ideal } MA = \frac{d_{in}}{d_{out}}$$

$$\text{efficiency} = \frac{W_{out}}{W_{in}} \times 100\%$$

$$= \frac{\text{energy out}}{\text{energy in}} \times 100\%$$

$$= \frac{P_{out}}{P_{in}} \times 100\%$$

ideal efficiency = 100%

e.g.

You use a lever to lift a car. You apply 500.0 N of force through 1.20m of distance to lift the car 0.11m.

a) What is the ideal mechanical advantage of the lever? What force could it apply on the car if it is ideal?
If the lever only applies 4.00×10^3N of force on the car,

b) what is the Mechanical advantage of the lever?

c) What is the efficiency of the lever?

P210 Q13-16

P211 CR 2.1-2.4

Next class: Energy Ch 11

$$IMA = \frac{d_{in}}{d_{out}} = \frac{1.20m}{0.11m}$$

$$\boxed{IMA = 10.9\ X}$$

$$MA = \frac{F_{out}}{F_{in}} = 10.9$$

$$F_{out} = 10.9 \times 500N$$
$$= \boxed{5400N}$$

b) $MA = \frac{F_{out}}{F_{in}} = \frac{4000N}{500N} = \boxed{8.0X}$

c)

c) $efficiency = \frac{W_{out}}{W_{in}} \times 100\%$

$= \frac{F_{out} d_{out}}{F_{in} d_{in}} \times 100\%$

$= \frac{4000N \times 0.11m}{500N \times 1.2m} \times 100\%$

$= \boxed{73\%}$